Jet energy measurement

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Jet energy corrections for $L = 2 * 10^{33}\, pb^{-1}$

Jet rates at $L = 2 * 10^{33}\, pb^{-1}$

Tracker information for jet energy measurement

Radiation damage studies:

calorimeter performance after 10 years of LHC operation

Factors affecting on jet energy measurements:

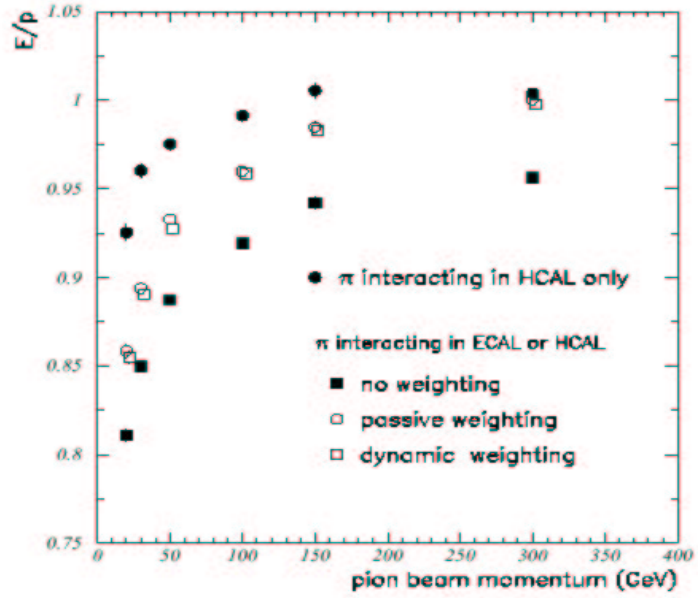
Non linear response of calorimeter to charged hadrons $e/h_{HCAL} = 1.39$ $e/h_{ECAL} = 1.6$

Magnetic field

Transverse leakage of hadron shower out of jet cone

Dead materials and cracks

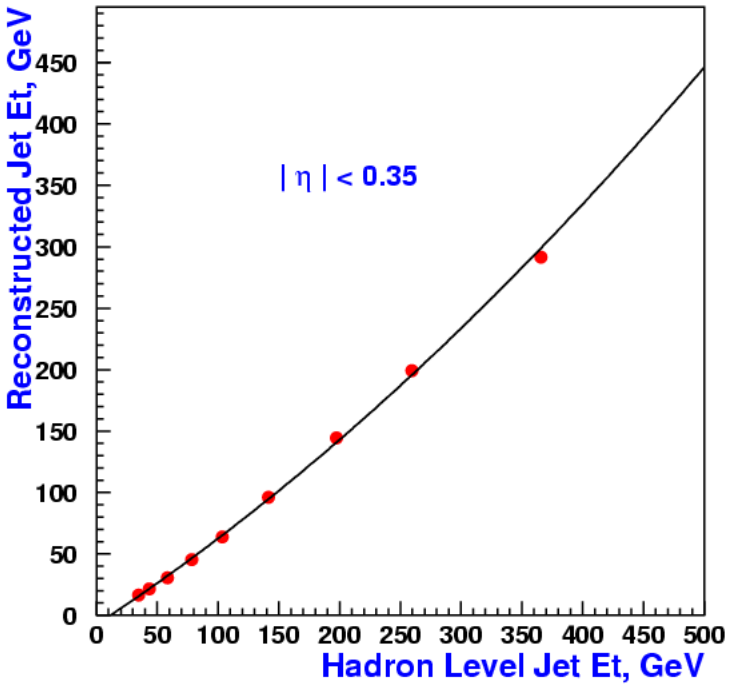
Minimum bias events in high Luminosity



1996 beam test

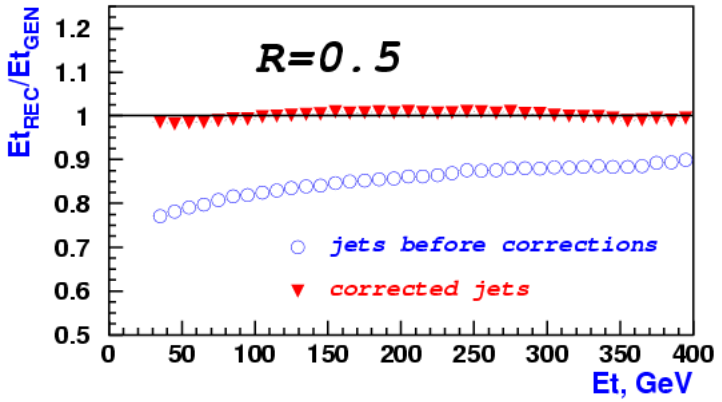
Jet energy corrections for $L = 2x10^{33} cm^{-2} s^{-1}$

ORCA Results

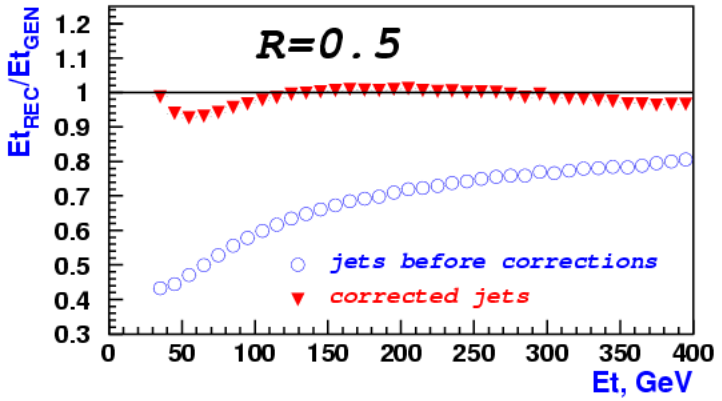


$$Et_{REC} = A * Et_{GEN}^{\ 2} + B * Et_{GEN} + C$$

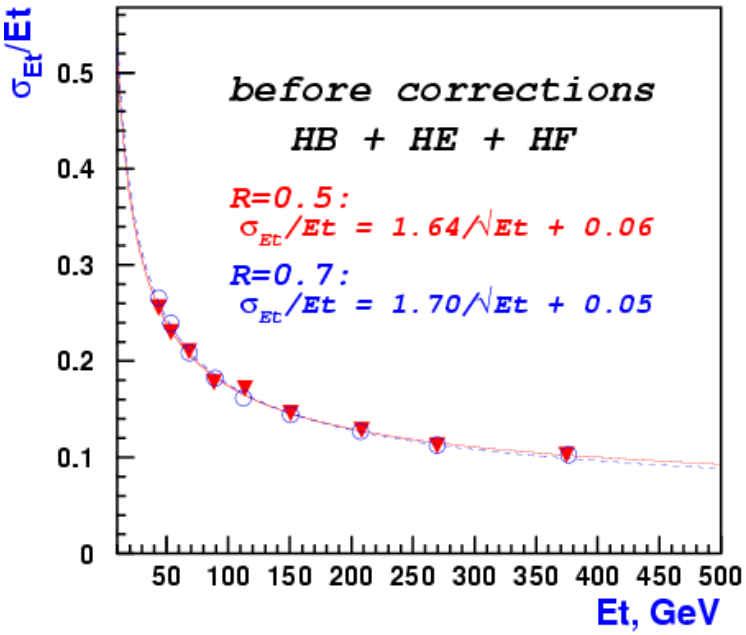
Off-line jets: $R_{GEN} = 0.5$ $R_{REC} = 0.5$

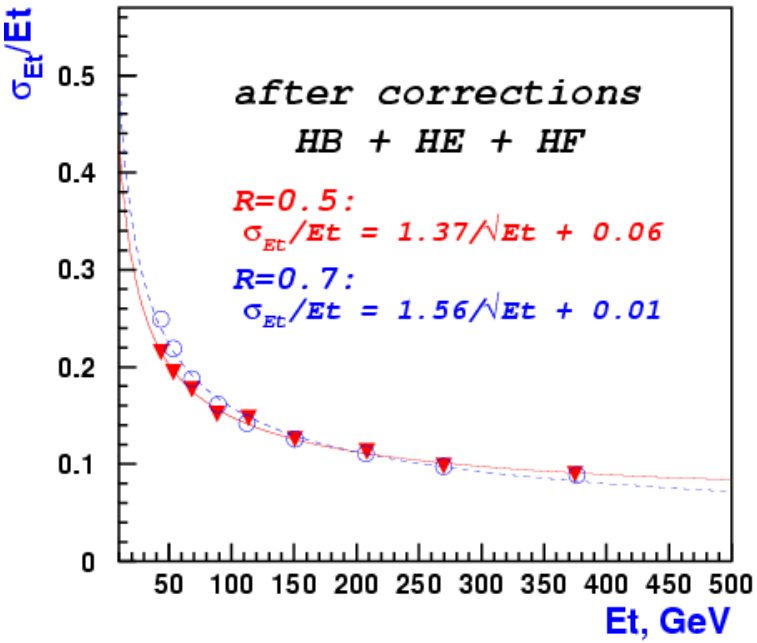


L1 jets, $R_{GEN} = 0.5$

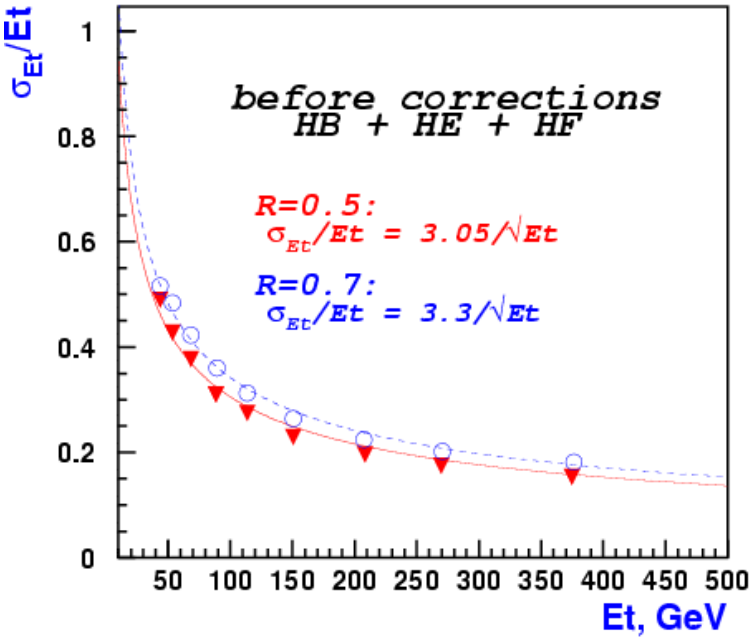


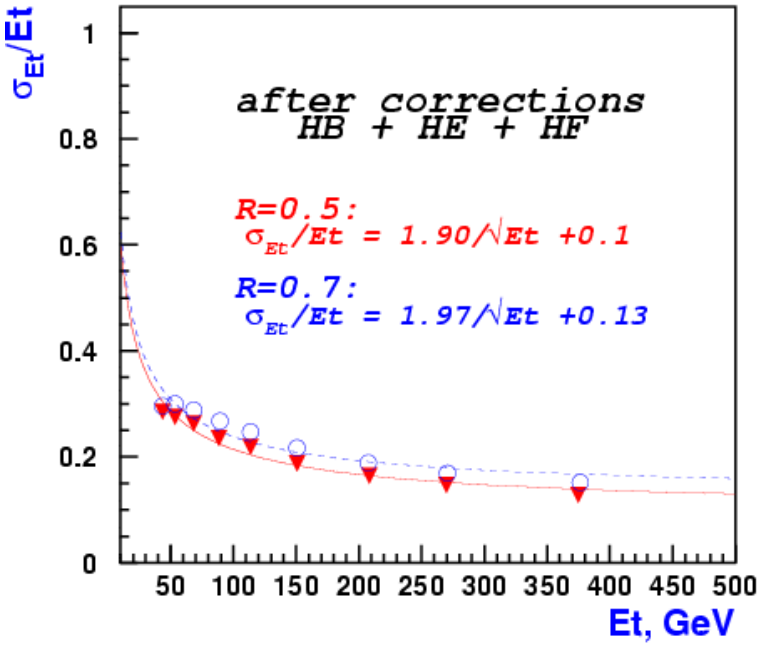
Resolution for Offline Jets Before and After Corrections



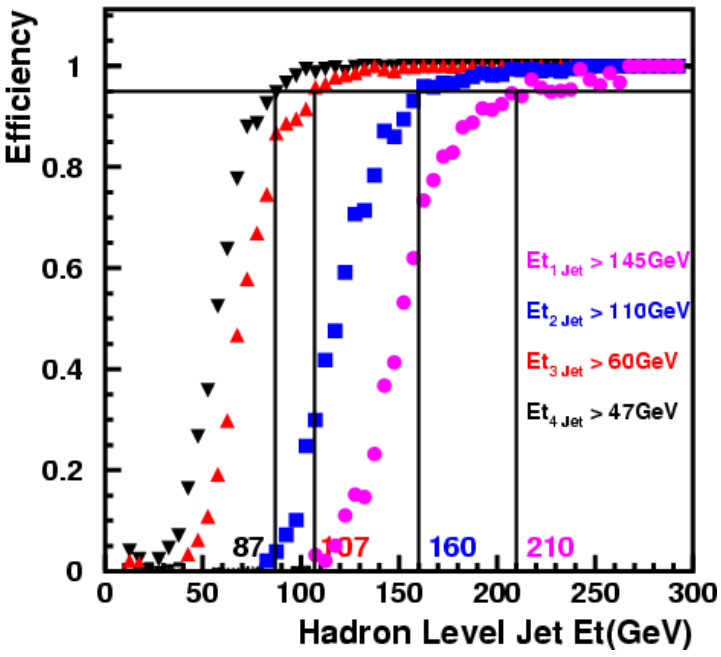


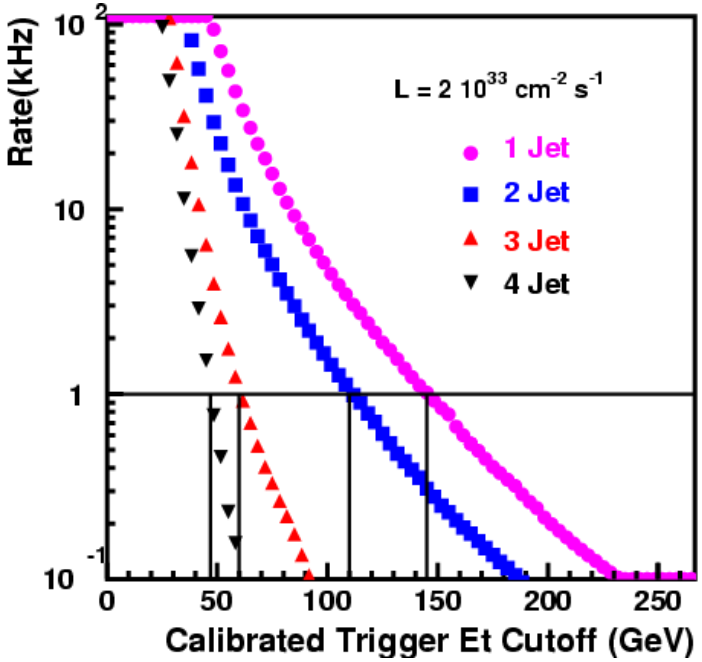
Resolution for L1 Jets Before and After Corrections



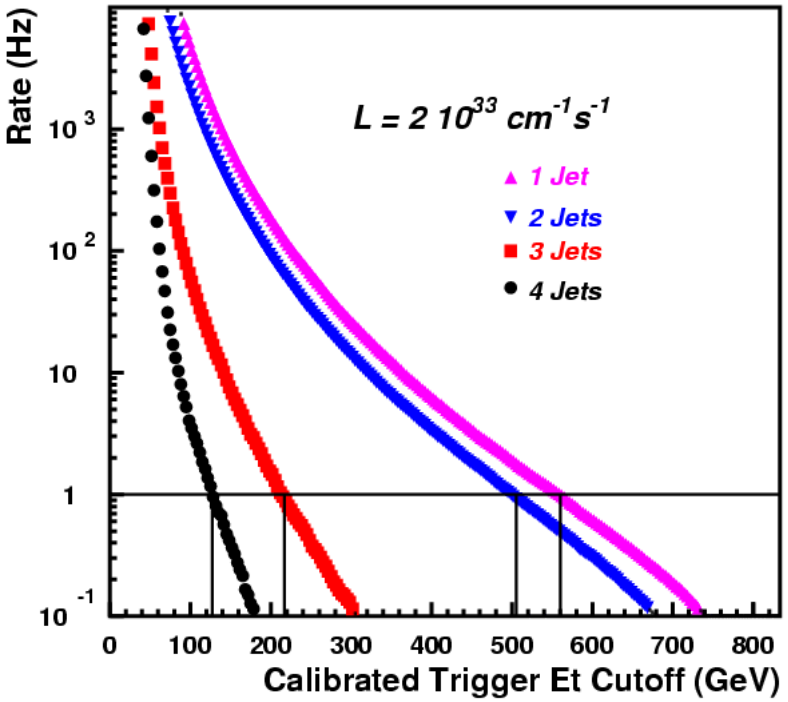


L1 jet rates $L = 2x10^{33} cm^{-2} s^{-1}$





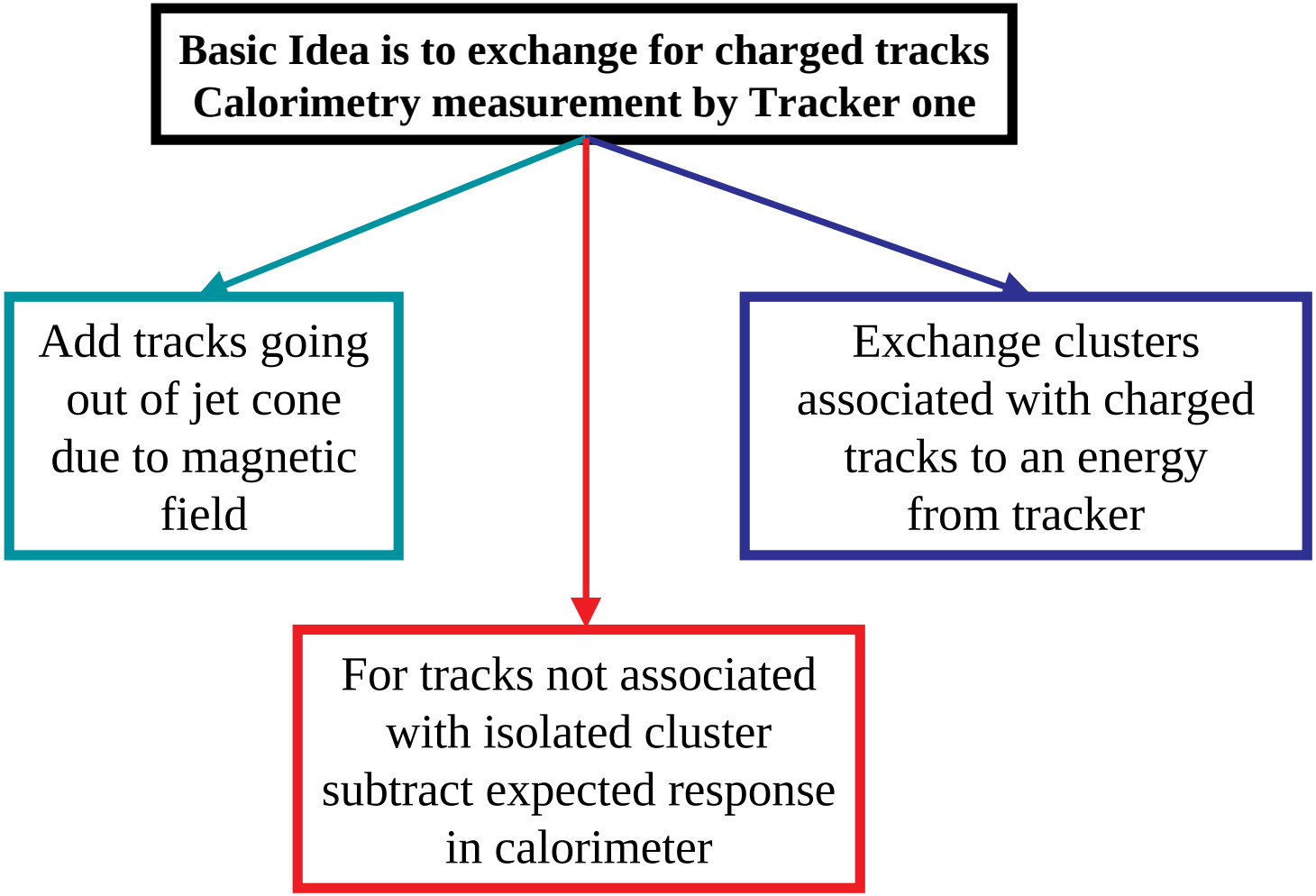
HLT



	1Hz	1kHz
1 Jet	560GeV	145GeV
2 Jets	505GeV	110GeV
3 Jets	217GeV	60GeV
4 Jets	127GeV	47GeV

1Hz - is possible rate for 1,2,3 and 4 Jet events from HLT to tape

Using Tracker Information for Jet Energy Measurement

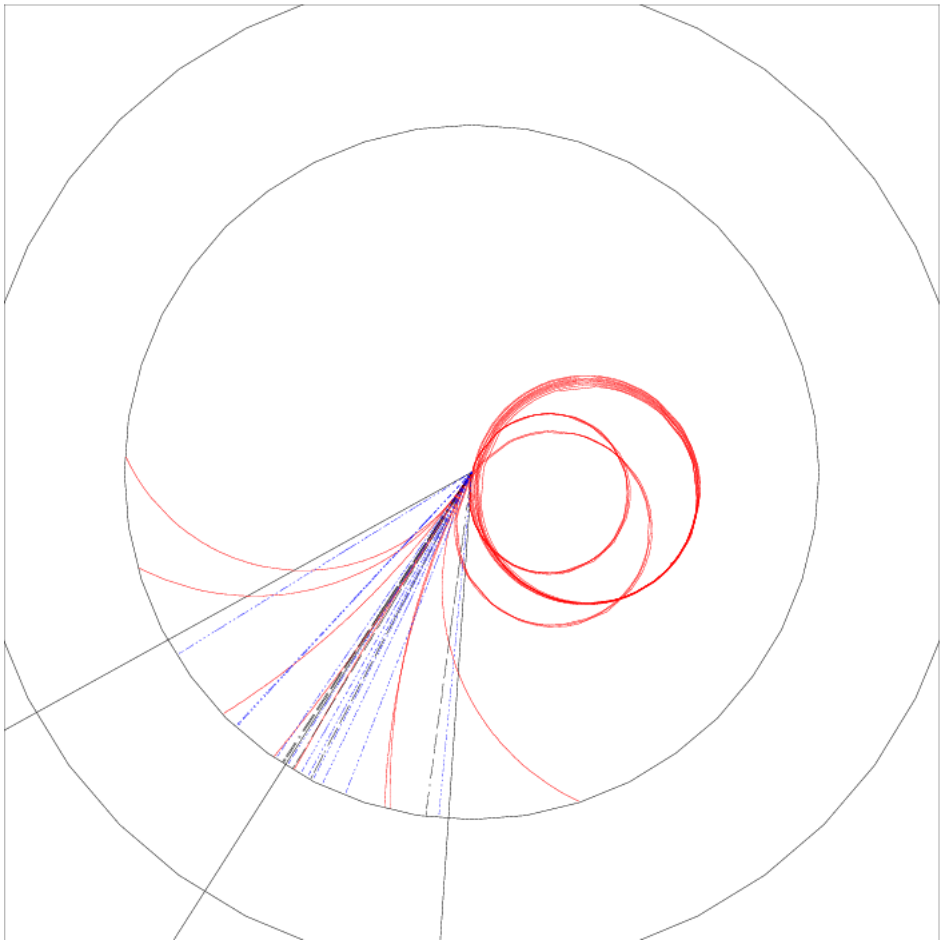


Tracks out of jet cone

Example:

barrel jet with $E_T = 100 GeV$

A.Nikitenko



Tracks associated with calorimeter clusters (Dan Green)

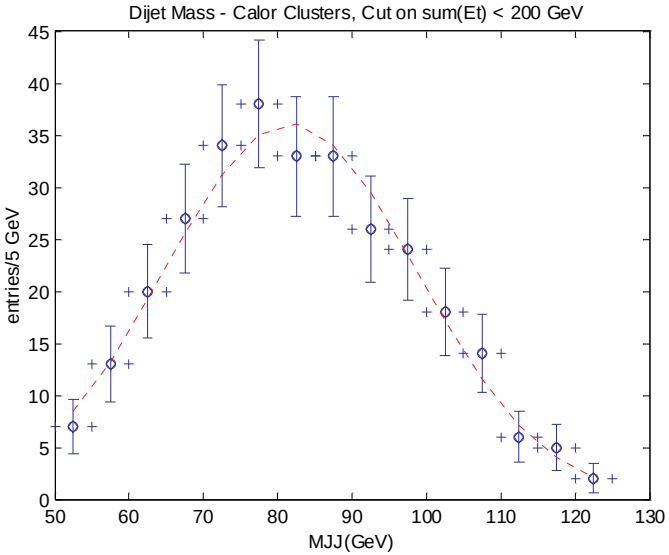
Step1: Clusters in ECAL 3x3 crystals and HCAL 3x3 towers were found.

Step2: Matching between tracks and clusters was done (both in distance and energy)

Step3: Clusters were replaced by tracks

Dijet mass for Z(120):

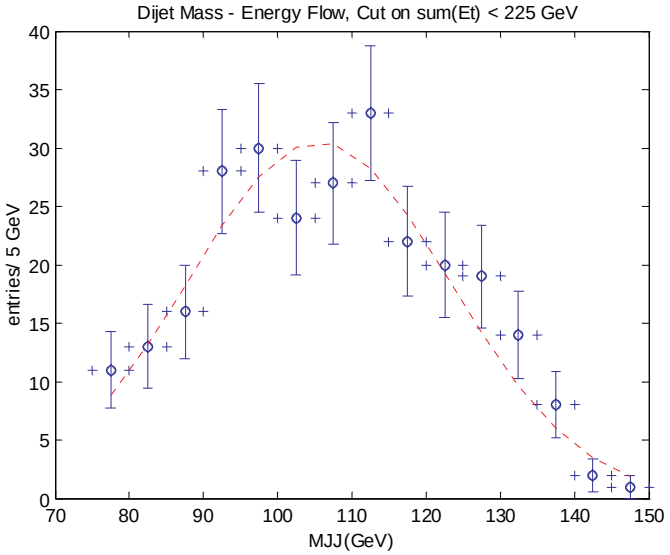
Without tracker info:



$Mean = 81.7 \pm 1.1 GeV$

$Sigma = 17.1 \pm 1 GeV$

With tracker info:



$Mean = 105.5 \pm 1.1 GeV$

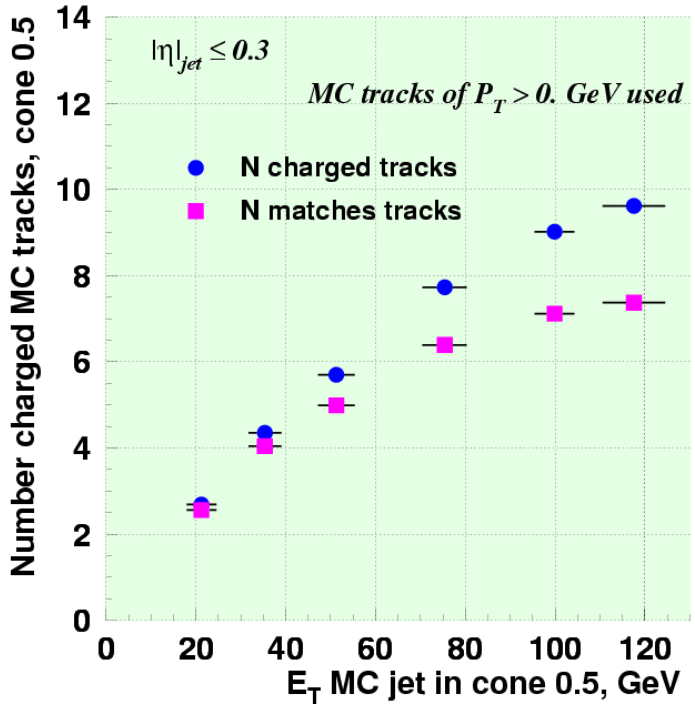
$Sigma = 17.1 \pm 1 GeV$

Tracks associated with calorimeter cluster (I.Vardanyan, O.Kodolova)

Difference from Dan's procedure:

Another algorithm of cluster reconstruction was developed (3x3 ECAL crystals and 3x3 HCAL towers were reconstructed around *entry point of track* in ECAL).

Energy difference between tracks and clusters was used for matching

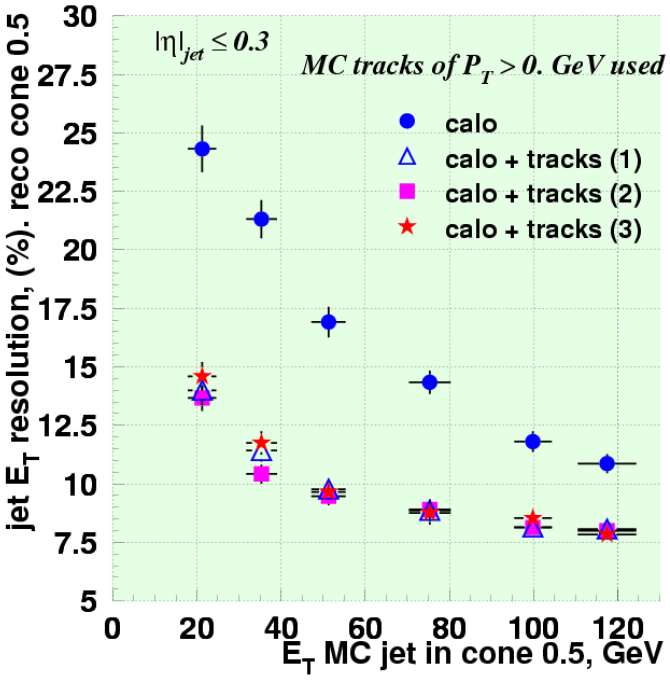


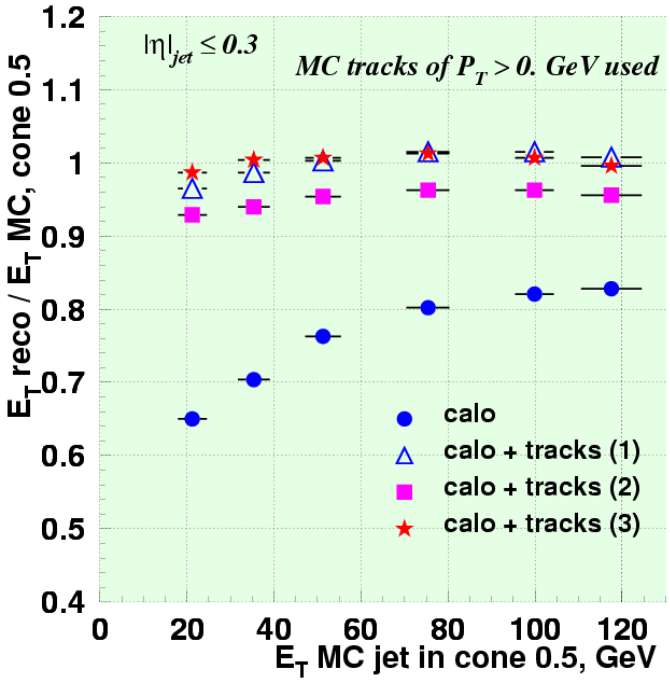
Resolution and mean Et_{REC} / Et_{GEN} for different MC jet energy

‘ calo’ - reconstruction using only calorimeter information

‘ calo + tracks(1)’ , ‘calo + track(2)’ - two methods of expected calorimeter response subtraction + tracks out of jet cone

‘ calo + tracks(3)’ - expected calorimeter response subtraction + exchange energy of matched cluster with energy of track +tracks out of jet cone





Radiation Damage Studies in HE

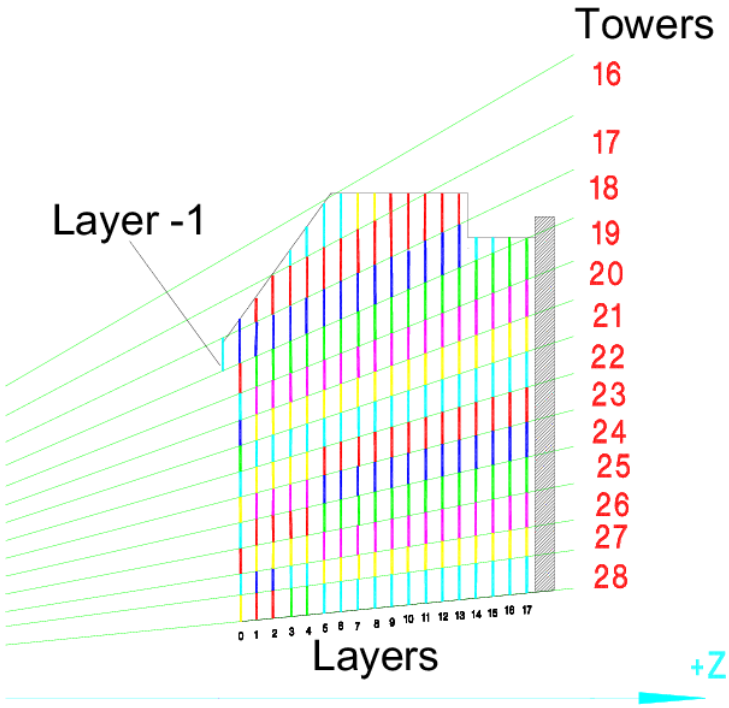
Simulation Model:

Light yield reduction from scintillating tiles due to irradiation

Not yet included:

Transparency deterioration of scintillating tiles

Reduction of attenuation length of WLS fibers



Doses:

The latest from Mika Huhtinen for $|\eta_{EE}| < 2.9$

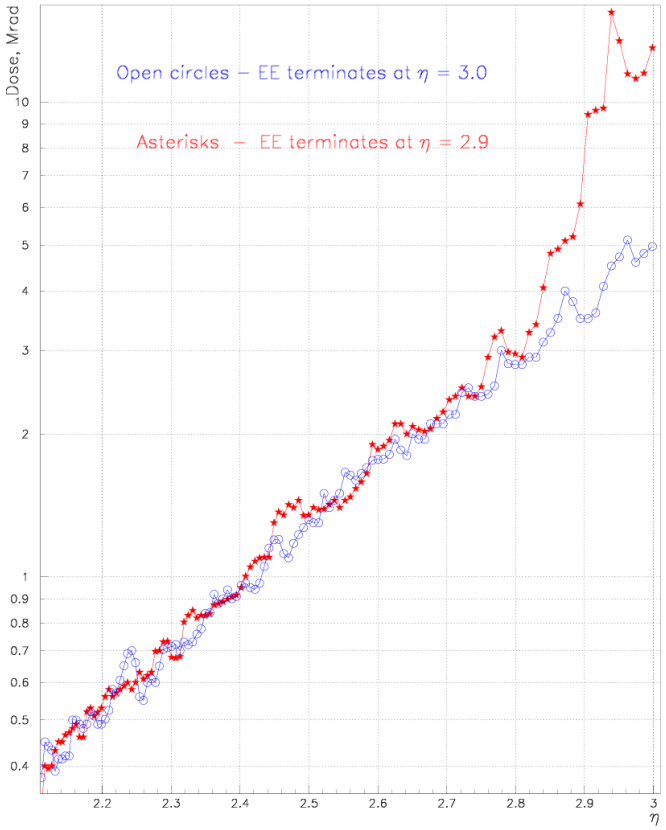
(CMS IN-2001/050)

CMSIM121:

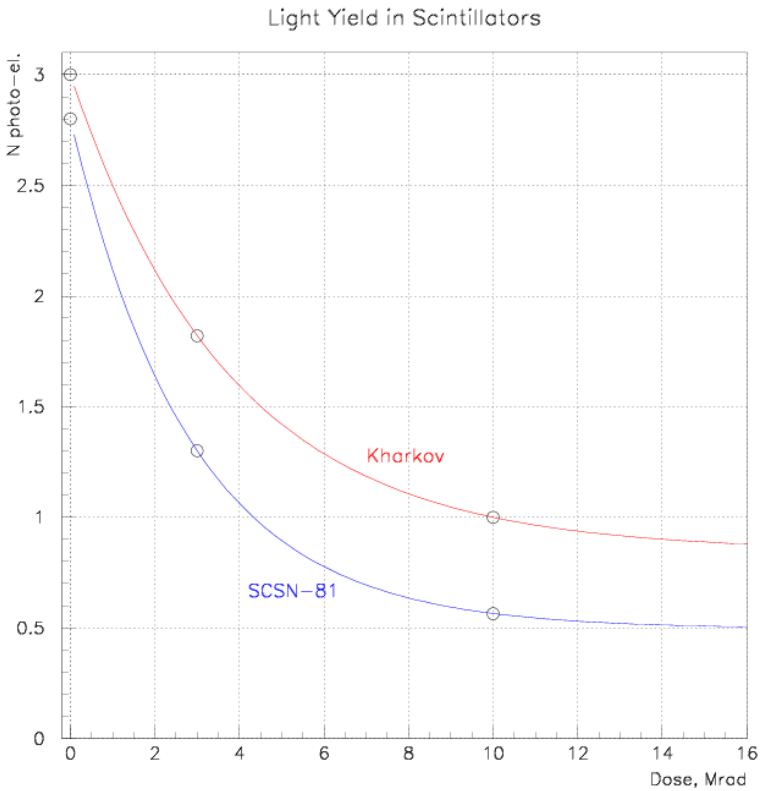
No noise

No photostatistic

Doses absorbed in Layer1 after 10 years:

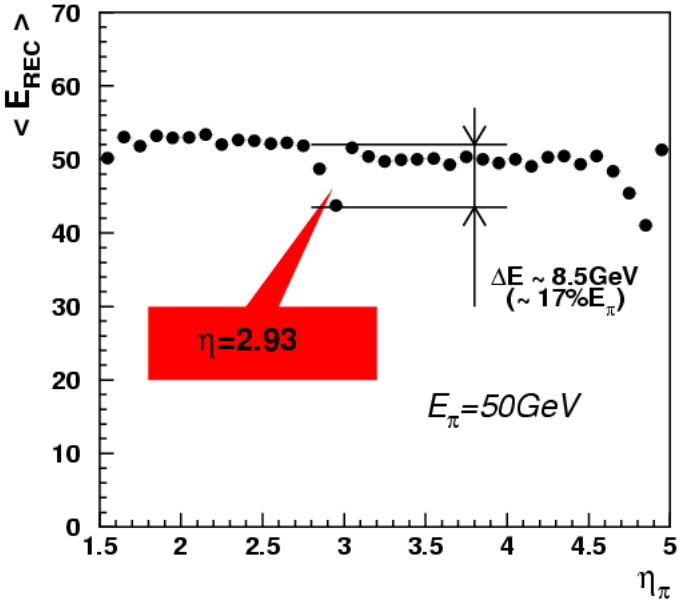


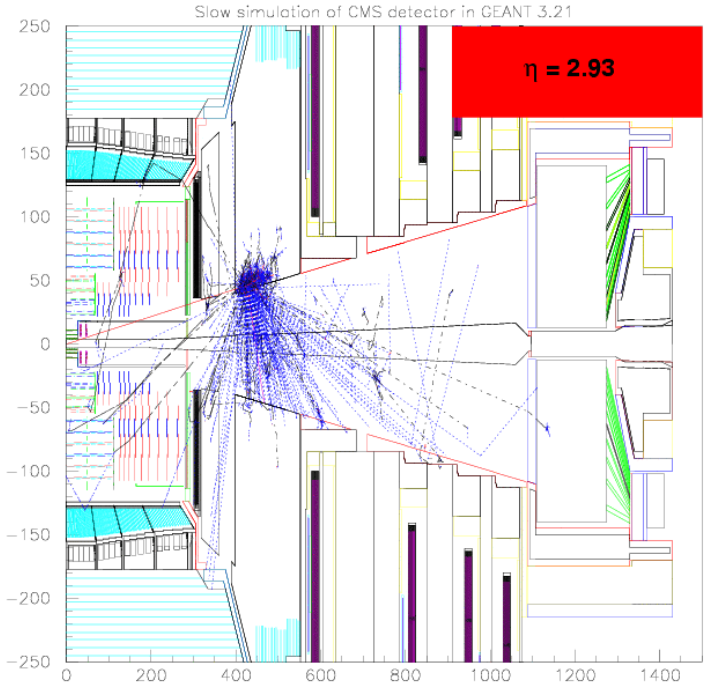
Light Yield SCSN-81 (Bicron) and Kharkov(UPS-98):



Maximum dose is ~15Mrad, expected light yield decrease is in ~5 times

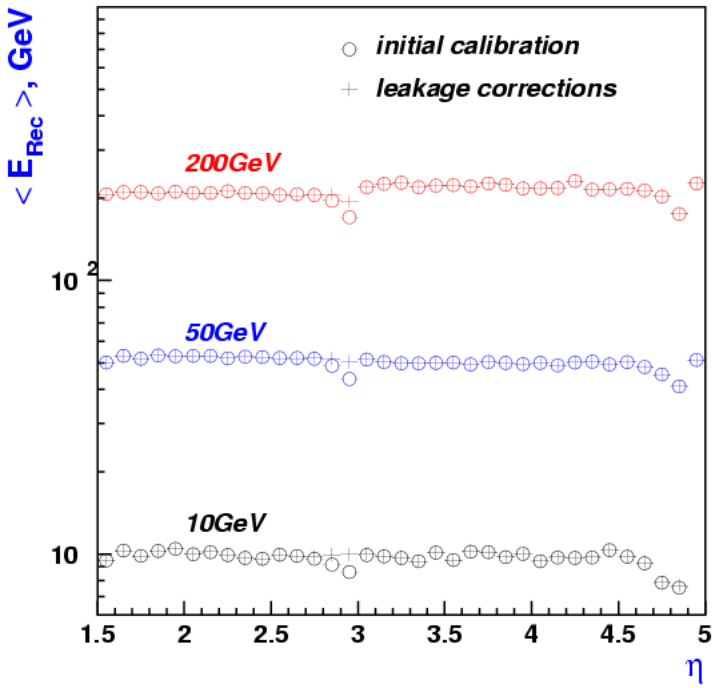
Leakage corrections





Response was corrected using additional correction coefficients

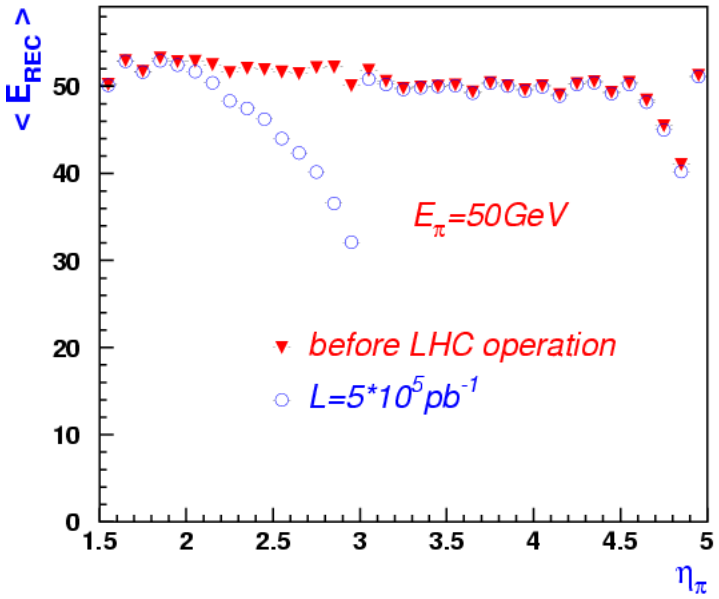
Leakage Corrections



Correction coefficients derived for 50GeV pi-mesons are valid also for other values of pion energies

After Irradiation $L = 5*10^5\ pb^{-1}$

(10 years of LHC operation)

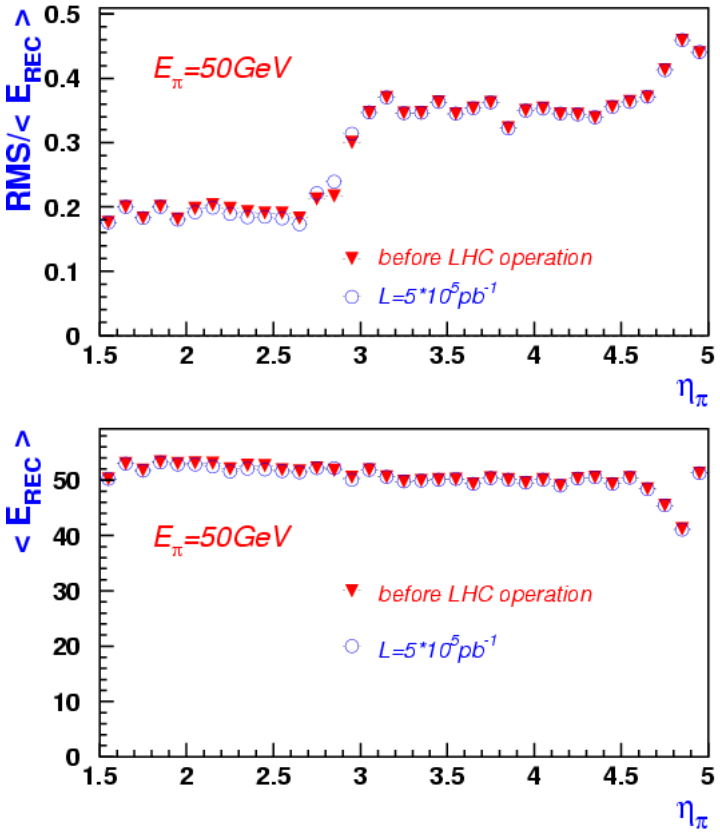


Monitoring of the average values of signals from each of readout segments helps to recover HE response

….but only if deterioration of photostatistic will not play main role

non uniformity is ~40%

After Corrections for radiation damages



Resolution before and after irradiation looks the same

Reconstructed energy before and after irradiation almost coincide

Summary

Tracker information improves jet energy resolution and linearity of calorimeter response.

Shower leakage through HE boundary leads to 17% reduction in response

The degradation of HE signal due to radiation damages after 10 years of LHC operation is up to 40%.

Response and resolution can be recovered using monitoring of signals from HE towers.